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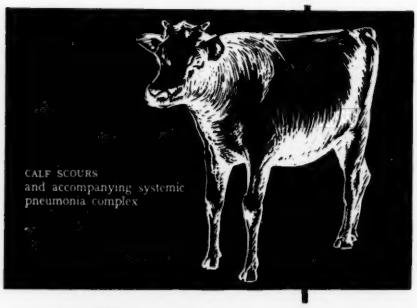
in sheep, swine and the dog.



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EDITORIAL

GOOD NURSING IS WORTH WHILE

In these days when the science of chemo-therapy is in full vogue and rapid resolution can be effected in an animal whose body is racked with a disease, which previously had defied all our efforts to cure or at the best entailed many weeks of chronic ill health and loss of use or production, it is well to remember that man is not entirely supreme and his new conquests could not be achieved without the co-operation of nature's own beneficial forces. In spite of the advent of the wonderful antibiotics and the sulpha group of medicaments, it would be correct to say that these things are adjuvants only and nature is the true master of the operation.

In the realm of surgery the same stipulation applies with equal veracity. Great advances in anaesthesia have enabled surgeons to explore all parts of the body and practise their craft on tissues and organs which were inviolate only a few years ago. Operations beyond the comprehension of our fathers are performed every day. Surgeons can delve in the interior of the heart and in the cranium, but their technical skill would be of no avail without the power of nature's natural forces.

Whatever be the disease or abnormal state, nature trys to effect resolution. Sometimes she can effect a repair under her own volition and power, and human aid only accelerates the process. At other times when her efforts flag or are in vain the physician or surgeon can provide such aid as will tilt the scale towards a successful resolution. We must always remember that animals and men did recover from fell diseases before many of the modern specific chemo-therapeutic agents were discovered.

Why and how did they recover? It was because the forces of natural resistance were able to overcome those that would destroy. Our aim should be to make full use of benificient nature. How can the natural forces be mobilised, stimulated, conserved, and helped in their great endeavour? One of the best ways of achieving this end is by attending to the good care and hygiene of the patient. This means good nursing. To rely entirely on the effect of a specific drug or some brilliant surgical

technique debases the animal body to the status of an internal combustion engine afflicted with a defect in one of its bearings. It ignores the fact that living tissue fights vigorously to repel invaders, promote repair and compensate for defects in function. A mechanical contrivance of itself can make no effort towards repair, and a fatal termination is inevitable. There have always been some doctors and veterinary surgeons who could obtain a better percentage of recoveries than their fellows. If one studies their methods one will find that their successes did not stem primarily from the use of any special drug or surgical technique. They were masters in the care of their patients and they took great pains to instruct those who were responsible for the nursing. They could marshall the nurses in the fight for life and they could inculcate the will to live into the patient. Some people are good nurses by natural instinct, and others learn the art by precept.

It is stupid to perform an elaborate and skilful operation and then to hand the patient over to attendants or owners completely untutored in the elementary principles of post operative care. Serious emergencies occur in the best of regulated circumstances but minor upsets of no great consequence can bring unnecessary trouble and anxiety to those who sit and watch in the night.

It is essential that medical men and veterinary surgeons should be practical and efficient exponents of the art of nursing the sick and able to give sound instructions to others. It is an art which cannot be learnt from a book.

No man could make a shoe and fit it on a horse unless he had served a period in a farrier's forge, neither could be make a bed that would be comfortable or a poultice that would stay in place unless he had learnt the art by precept and practical experience.

The art of good nursing and the gentle and confident care of the sick is still one of the most powerful agents in a healer's armamentarium and, it would be of no disadvantage to those that are sick if their doctors were to devote a little less time to the survey of the marvels of science and devote a little more time to an appreciation of the graces of kindness and compassion which are so evident in all good nurses.

CHANGES IN SIZE OF THE GASTRO-INTESTINAL TRACT, LIVER AND KIDNEYS OF THE LABORATORY RAT AT DIFFERENT LIVE WEIGHTS AND ON DIFFERENT DIETARY REGIMENS

A. BROWNLEE and W. MOSS

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Warner, Flatt and Loosli (1956) and Brownlee (1956) found that in cattle the extent of development of the rumen papillae is influenced by the type of diet. As an adjunct to such investigations it was considered desirable to study the changes which occur in the gastro-intestinal tract and also the liver and kidneys of a small laboratory animal such as the rat on being fed differing diets. That changes due to diet do occur in the alimentary tract of the laboratory rat has been recorded by Brobeck, Tepperman and Long (1943) who found that rats with hypothalamic lesions showed hyperphagia and, resulting from this, the gastro-intestinal tract became hypertrophied and the liver enlarged. These workers attributed the increase in size of the gastro-intestinal tract to the hyperphagia as this condition was also found in rats trained to eat a large quantity of food at one time (Tepperman, Brobeck and Long 1943) by restricting their access to food to one period of three hours each day. Morgan and Yudkin (1957) reported an enlarged caecum in rats fed sorbitol for a few weeks, so that factors, other than total amount of food consumed or restriction of feeding time, may influence organ size. Luck (1936) found hyperplasia and hypertrophy of the liver in rats fed on a high protein diet. Cole and Hart (1938) found that in rats the food consumption rose during pregnancy and still more during lactation. Campbell, Innes and Kosterlitz (1953) also found increased food consumption during pregnancy. Kennedy and Pearce (1958) found in young rats a high caloric intake and rapid somatic growth along with accelerated growth in size and number of cells in liver; in adult rats with hypothalamic lesions there was hyperphagia with increase in size of liver but no significant increase of the skeleton. Kennedy, Pearce and Parrott (1958) found in albino rats a hypertrophy of the liver to twice normal size during 2nd and 3rd weeks of lactation; they associated this change with increased food intake during this period; the liver returned to its weight at parturition within 3 weeks of weaning. Kennedy (1957) found that weanling rats eat twice as much as adults in relation to body weight. Woodman, Evans, Callow and Wishart (1936) and McMeekan (1940) record increased kidney weight in pigs fed a high protein diet. Robertson and Reid (1952) prepared a graph of the basal energy output in normal human subjects of ages three to seventy-five or over. This graph shows that the metabolic rate is highest in the very young and falls rather steeply till adolescence after which the fall, though continuing, is more gradual. In our early experiments it was observed that, irrespective of the dietary treatment, the percentage organ weight of the smaller rats tended to be higher than that of the larger and this observation led to the work carried out in Section 1.

Section 1

Animals and Methods

Albino-Wistar rats from a closed population stock, being fed on the following stock diet, were used.

Wheat (crushed whole) ...	17.92%	Biscuit Meal	17.92%
Bran	8.40%	Sodium Chloride ...	0.40%
Oats (crushed)	17.92%	Meat and Bone Meal ...	8.40%
Barley Meal	8.40%	Milk (fresh)	13.36%
Fish Meal	5.04%	2% Cod Liver Oil was added on one day each week.	
Dried Yeast	2.24%		

Virgin, normal rats of a wide range of differing live weights were destroyed in batches either by stunning or by chloroform. Post-mortem dissection was carried out within 20 minutes to 3 hours of death. The liver was excised and exuded blood removed on blotting paper; any fat was removed from the kidneys; the œsophageal, duodenal and mesenteric attachments of the stomach were severed, and contents removed. The intestines were severed from their mesentery, cut into suitable lengths, measured, and their contents expressed with a blunt scalpel. These organs were weighed immediately after their preparation. The organ weights, calculated as a percentage of the body weight and plotted against body weight, are shown in Chart 1. In addition 30 pairs of rats, after they had reared three litters, were dealt with similarly, and are also shown on Chart 1. Organ weights of a similar range of hooded rats, when charted, showed a picture similar to that for the albinos. A total of 68 litters from thirty breeding pairs of rats were at weaning put on to the following diet:—

Wheat	28.0 lb.	Yeast	3.00 lb.
Bran	13.5 lb.	Biscuit Meal	28.00 lb.
Porridge Oats	28.0 lb.	Meat and Bone Meal ...	7.50 lb.
Barley Meal	13.5 lb.	Sodium Chloride	0.75 lb.
Fish Meal	7.0 lb.	Whole Milk	20.75 lb.

The solids were ground to a flour, kneaded with the milk, and baked into biscuits.

Daily records of food consumed and weekly records of live weights were kept. Each litter was destroyed by chloroform when the males had reached a particular average weight in a pre-arranged scheme designed to give a weight range, 50-340 g.; the organs were prepared in the same manner as described above.

Results

Chart 1 shows that the percentage weights of the liver and gastro-intestinal-tract are highest in the small animals and fall with increasing live weight. The exceptions to this rule are the breeding females destroyed after rearing three litters; these show increased liver and gastro-intestinal tract percentage weights above those expected for their live weight. The kidney weights (not illustrated here) show, in the virgin stock, a pattern similar to that for the liver and for the gastro-intestinal tract but the percentage organ increase in the breeding females amounted to only about 0.1 per cent.

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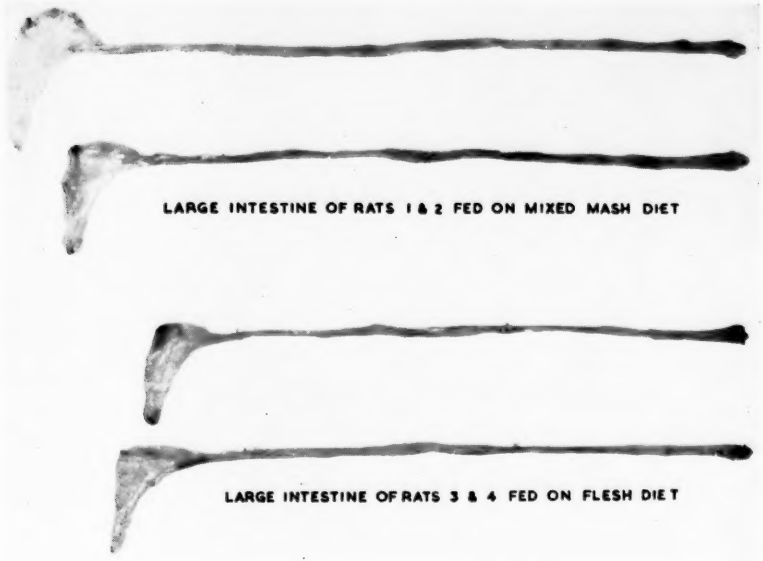
PLATE I

INFLUENCE OF DIET ON DEVELOPMENT OF GASTRO-INTESTINAL TRACT IN THE RAT



LIVE WEIGHT OF RAT	LENGTH OF LARGE INTESTINE	WEIGHT OF LARGE INTESTINE
207 Grms.	23·7 Cms.	1·51 Grms.
210 Grms.	22·1 Cms.	1·57 Grms.
207 Grms.	20·2 Cms.	1·04 Grms.
214 Grms	20·6 Cms.	1.10 Grms.

FIGURE I

(Article by Brownlee, page 225)

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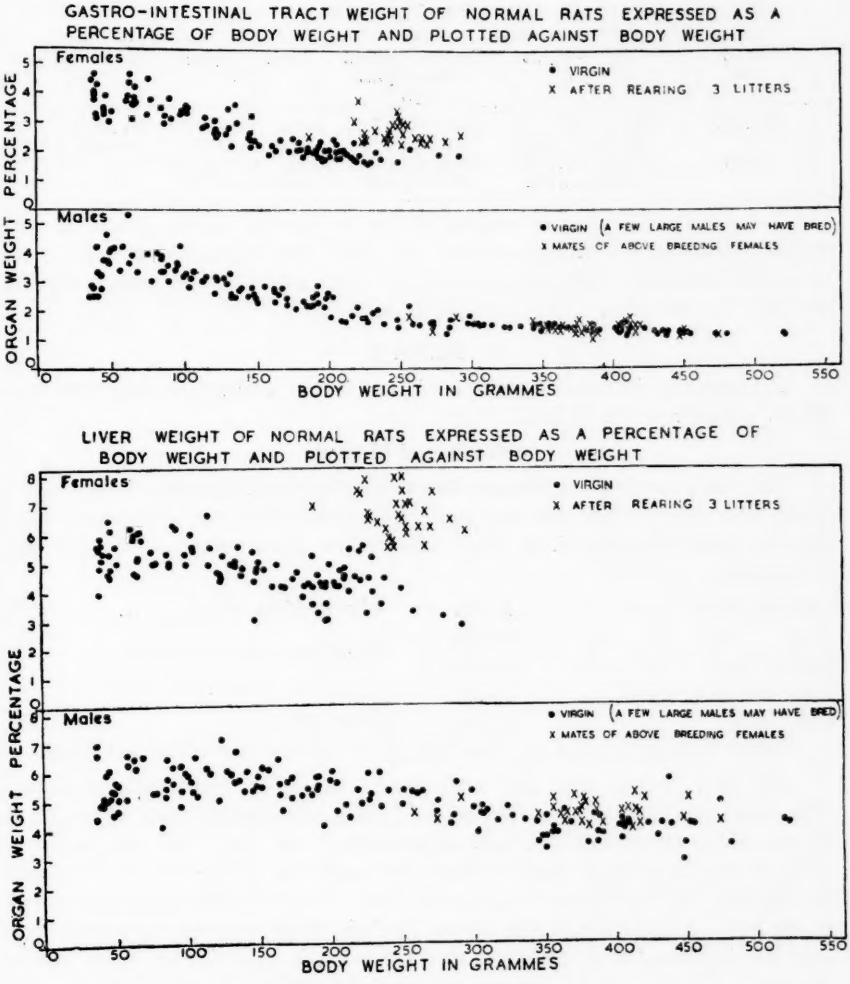
The percentage organ weights of the rats in the 68 litters, when charted, show a picture very similar to that of the organs of the virgin rats shown in Chart 1. The food consumed by these litters, when expressed as the calculated amount eaten by a rat of 100 g., was found to be highest in the young rats and to fall with increasing live weight. For example litters of average weights varying from 70-100 g. weight

CHART No. I


GASTRO-INTESTINAL TRACT WEIGHT OF NORMAL RATS EXPRESSED AS A PERCENTAGE OF BODY WEIGHT AND PLOTTED AGAINST BODY WEIGHT
Females
• VIRGIN
X AFTER REARING 3 LITTERS
Males
• VIRGIN (A FEW LARGE MALES MAY HAVE BRED)
X MATES OF ABOVE BREEDING FEMALES
ORGAN WEIGHT PERCENTAGE
BODY WEIGHT IN GRAMMES
LIVER WEIGHT OF NORMAL RATS EXPRESSED AS A PERCENTAGE OF BODY WEIGHT AND PLOTTED AGAINST BODY WEIGHT
Females
• VIRGIN
X AFTER REARING 3 LITTERS
Males
• VIRGIN (A FEW LARGE MALES MAY HAVE BRED)
X MATES OF ABOVE BREEDING FEMALES
ORGAN WEIGHT PERCENTAGE
BODY WEIGHT IN GRAMMES

consumed daily 15-17 g. per 100 g. live weight and litters of average weight 260-300 g. consumed only 6-8 g. per 100 g. live weight. Thus a fall in organ percentage weight is accompanied by a fall in the percentage weight of food consumed.

That the fall in the percentage organ weight with increasing live weight is not equal in the case of all organs is illustrated in Table I which shows that in these 30 breeding females the gastro-intestinal tract median weight remains higher than that of the 30 males whereas, in the case of the liver and of the kidneys, the median organ weight of the males surpasses that of the females.

TABLE I

Median and Range for Weights or Organs from 30 Breeding Pairs of Rats after their Third Litter.

Sex of rats	*Live Weights (g.)*	*Gastro-intestinal tract weights (g.)*	*Liver Weights (g.)*	*Kidney Weights (g.)*
Females	Range 187-294 Median 249.5	Range 4.46-8.35 Median 6.56	Range 13.0-20.32 Median 16.34	Range 1.7-2.27 Median 1.925
Males	Range 257-474 Median 379.5	Range 3.54-7.07 Median 4.98	Range 11.45-22.48 Median 17.13	Range 1.48-3.24 Median 2.51

A feature of these organ weights, as can be observed in the charts, is their variability even in rats of approximately the same live weight and undergoing the same food treatment. This appears especially noteworthy when we consider that the rats were obtained from a closed population stock.

Section 2

A comparison is made of organ size in rats fed for a period on mash with those fed for a similar period on flesh.

Animals and Methods

The data given in this section are the combined results of a number of experiments. Young male Albino-Wistar rats were used. They were maintained on the experimental diets for periods varying from 35-59 days. The mash used had the following composition.

Crushed Oats	5.6 lb.	Biscuit Meal	1.6 lb.
Bran	2.4 lb.	Proprietary full cream milk powder (reinforced with vit. D)	2.0 lb.
Barley Meal	1.6 lb.		
Meat and Bone Meal ...	2.4 lb.		
Fish Meal	0.4 lb.		

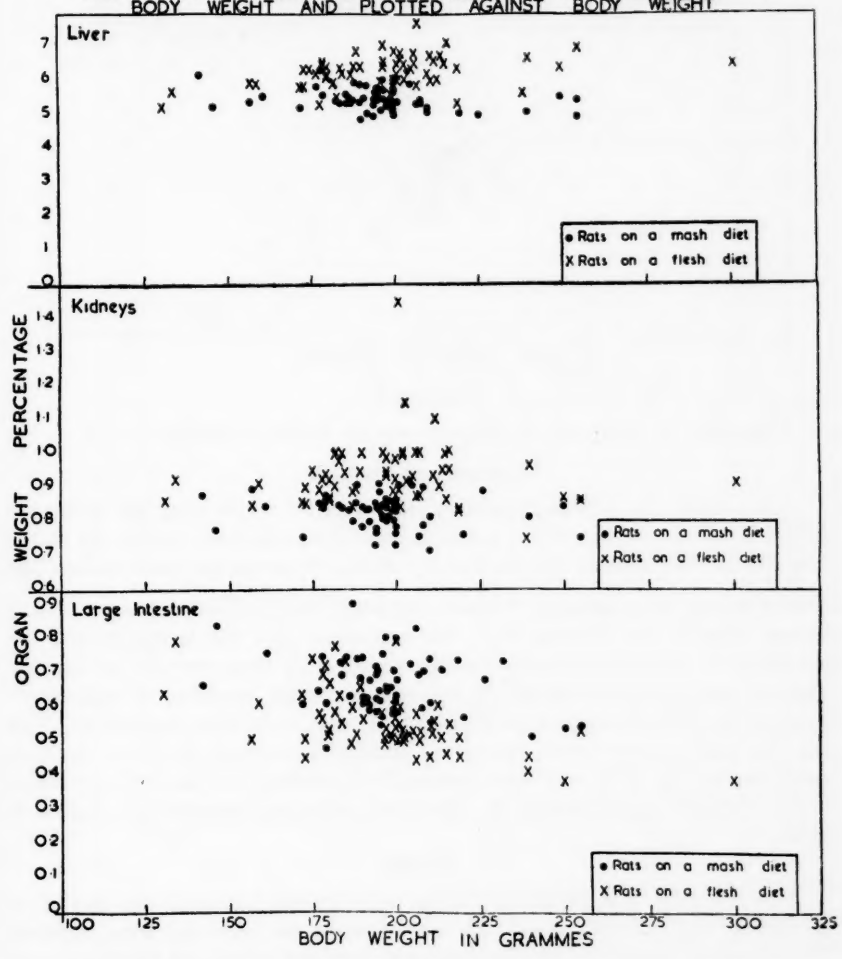
Before feeding 10 ml. of tap water per oz. of dry food was added and mixed.

For flesh feeding, mice were used (except for the 16 rats mentioned below). They were killed by stunning, then skinned, the gastro-intestinal tract removed and the remaining carcase fed. In early experiments it was found that rats tended to scour if the change from mash to flesh were made too quickly and in subsequent experiments a gradual change over was effected. The day's allowance was given all at one time. It was observed that rats on the flesh diet were more hungry at the time food was introduced than were those on mash and it is probable that *ad lib.* feeding was not being given in that the rats consumed the easily eaten parts first and were eager to consume these when food was newly introduced. Sixteen of the rats were fed on mouse, rat, rabbit, sheep and ox flesh. It was observed that the fæcal pellet was smaller in the flesh fed group than in the mash fed group. The rats were

destroyed by chloroform and the organs weighed as in Section 1. The percentage organ weights are plotted in Chart 2. The lengths of the large intestine per 100 g. live weight are plotted in Chart 3 and a photograph of the large intestine of two rats from each group is shown in Figure I.

CHART NO 2

ORGAN WEIGHTS OF RATS FED ON A MASH DIET AND OF RATS FED ON A FLESH DIET EXPRESSED AS A PERCENTAGE OF BODY WEIGHT AND PLOTTED AGAINST BODY WEIGHT

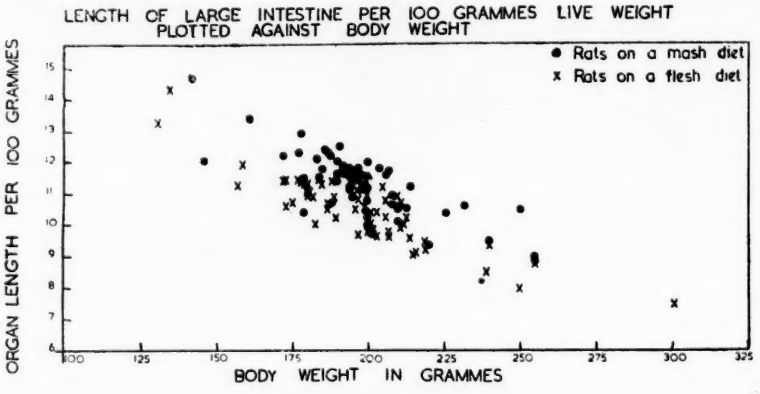


Results

Chart 2 shows that the liver and the kidneys of the flesh fed rats are larger than those of the mash fed although the rate of growth of the two groups was approximately equal. On the other hand the large intestine of the flesh fed rats is lighter and shorter

than that of the mash fed ones. The stomach of the flesh fed rats is usually larger than that of the mash fed and the graph (not included here) of the percentage weights of the stomach in flesh fed and mash fed rats is similar to that for the restricted-time rats shown in Chart 4. The reason for this is probably that, as noted previously, the flesh fed rats ate eagerly when food was first introduced thus producing a somewhat similar condition to that described in the next section.

CHART NO 3



Section 3

The effect of restricting the time allowed for feeding is studied.

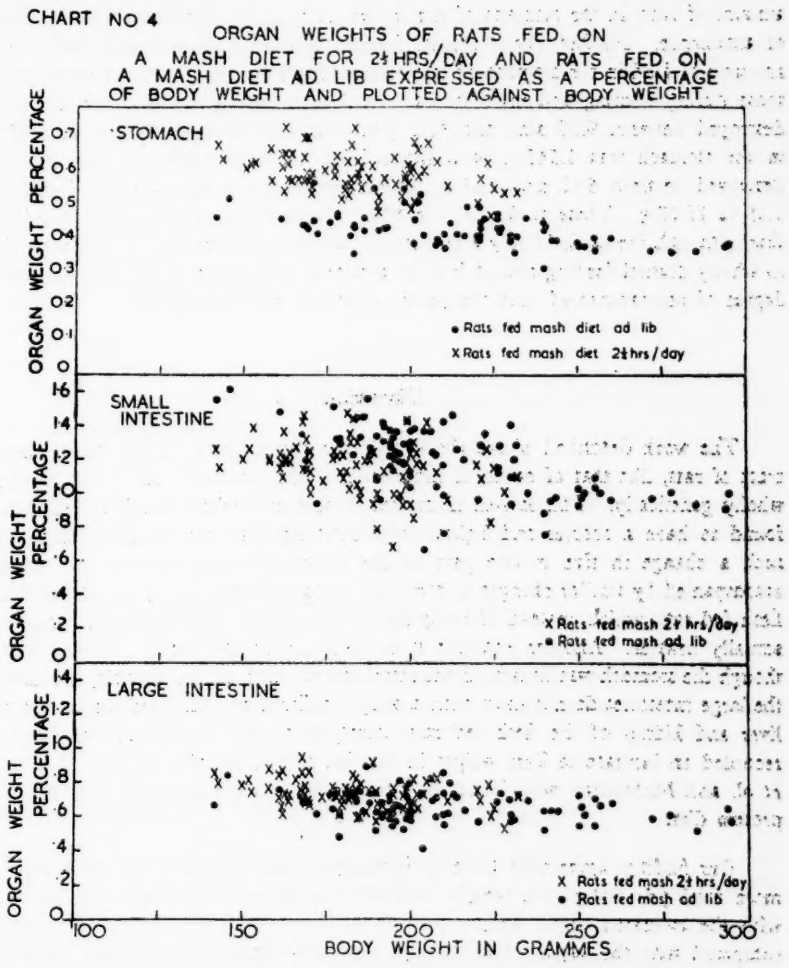
Animals and Methods

Male albino rats were used again and they were fed on the stock diet detailed in Section 1. Their average, initial weight in the four experiments carried out ranged from 113 to 194 grammes. On the first day of the experiment the restricted rats were allowed to feed for a period of 7 hours after which time all food was removed until feeding time on the following day. On succeeding days the feeding period was reduced by 1 hour each day until the final period of 2½ hours per day was reached. The rats were maintained on this 2½ hour regime for the remainder of each experiment, the duration of which varied from 22 to 44 days in the four experiments. Very soon, the restricted rats commenced to eat greedily immediately the food was introduced whereas the *ad lib.* rats were comparatively indifferent to the newly introduced food. The rats were destroyed by chloroform and organs weighed and charted as before.

Results

Chart 4 shows that the stomach of the restricted rats is heavier than that of the unrestricted and that this change does not extend to the small and large intestines. The stomach of rats trained to the restricted-feeding-time regime was found to contain large amounts of food compared with the, as a rule, much smaller quantity found in *ad lib.* rats of about the same live weight killed at the same time; e.g. in 10 restricted rats killed after having access to food for one hour and in 10 restricted rats killed after having access to food for 2½ hours the amounts of wet food in the stomach

averaged 12.54 g. and 13.12 g. respectively whereas the stomachs of 10 *ad lib.* rats destroyed 1 hour after feeding and of 10 destroyed 2½ hours after feeding contained average amounts of 1.86 g. and 0.835 g. respectively. In view of these results it was considered desirable to find out the normal feeding times of these rats.



Observations were made during a continuous period of 48 hours on 30 rats which were being allowed *ad lib.* feeding and were kept in 5 cages. The size of the rats varied from 60 g. to full grown. A unit was recorded for each minute during which a rat was observed to feed. On both days the rats showed an increase in the number of feeding times during the evening and night hours over those during the daylight hours with the peak periods 7.30 p.m. to 3.15 a.m. and 7.15 p.m. to 4 a.m. on the two days respectively. These observations were carried out on 21st and 22nd May,

1958. The longest period of abstinence from food shown by any individual rat was 9 hours; 4 other rats showed abstinence for 7 hours or over; the maximum period of abstinence shown by the others ranged from 6 hours 55 minutes down to 2 hours 50 minutes. Thus restriction of feeding time to one period of 2½ hours per day imposes a quite unnatural regimen on these rats. This is indicated both by the smaller amount of food in the stomach of the *ad lib*. rats and by their much shorter periods of abstinence. Further, the nocturnal feeding activity of such rats is shown by the amounts of food in the stomach of rats destroyed during daylight hours compared with those during evening and night hours. In 66 rats, being allowed food *ad lib*. and destroyed between 9.30 a.m. and 4.30 p.m., the median figure for weights of food in the stomach was 1.545 g. with range 0.0 g. to 7.8 g. while in 102 similar rats destroyed between 6.30 p.m. and 6.30 a.m. the median figure was 3.415 with range 0.15 to 15.07 g. These studies on the effect of restriction of time of feeding indicate that, although the rat is largely a crepuscular and nocturnal animal, it will soon change to wholly diurnal feeding should food be available only at that time. In this work the degree of permanence of such change in habits was not investigated.

Discussion

The work described above shows that the development of the gastro-intestinal tract of rats, like that of cattle, is influenced by the diet and thus is not determined wholly genetically. This is well illustrated in section 2 where the flesh-fed rats were found to have a shorter and lighter large intestine than the mash fed ones. That such a change in size in one part of the gastro-intestinal tract is not necessarily accompanied by similar changes in the other parts is illustrated by the stomach of the flesh fed rats, which, instead of being lighter than that of the mash fed controls, was actually heavier. Another example is to be found in the section 3 rats, in which, though the stomach was heavier in the restricted rats than in the controls, the small and the large intestines do not show such a weight difference. The increase in size of the liver and kidney of the flesh fed rats corresponds with the findings of Luck, who recorded an increase in liver weight in rats fed a high protein diet and of Woodman *et al.* and McMeekan who found an increase in kidney weights in pigs fed a high protein diet.

Our findings agree with those of Kennedy in that the small rat was found to eat more food per 100 g. live weight than did the larger animal and this corresponds with the increased organ weight, per 100 g. live weight, in the smaller animals as compared with the larger. Our findings also show that in the breeding female there is a greater gastro-intestinal tract weight than in the virgin female and this again indicates that the extent of organ development is not determined solely genetically. Kennedy *et al.* found that the liver weight increased during lactation and returned to parturition-weight level within three weeks of weaning and thus the liver weight can increase or decrease. Our breeding rats shown in Chart 1 were all destroyed at the time of weaning of their third litter. Other breeding rats whose history was not exactly known did not always show increased organ size and the findings of Kennedy

et al. may explain this anomaly. It is not clear from our work whether or not the increase in the liver weight is due to increased food consumption alone. That at least part of it is due to this cause is indicated by the fact that hyperphagia, following experimentally produced lesions in the hypothalamus, is also associated with increased liver size and that, in the young animal prior to breeding and when it is consuming a relatively large amount of food, the liver is large relative to the body weight. The increased food consumption plus the increased organ weight plus the rapid rate of growth, all of which occur in the younger ages, point to a higher metabolic rate at that stage and thus to a probable correspondence in the rat with what Robertson and Reid demonstrated to occur in the human subject.

When one considers the often quite wide scatter of plotted weights of organs of animals with the same treatment history it is apparent that variations in size of organs do occur from causes not within the experimental framework. Presumably these are determined genetically.

Summary

1. The weight of the liver, kidneys, and gastro-intestinal tract of laboratory rats per 100 g. live weight falls with increasing live weight. A similar fall occurs in the amount of food consumed per 100 g. live weight.

2. An exception to these rules is the breeding female in which an increase in weight of the liver and of the gastro-intestinal tract occurs and the food consumption increases.

3. Rats reared on a flesh diet show a shorter and a lighter large intestine than do similar rats reared on a mash diet.

4. Rats subjected to a regimen during which they are allowed to feed only during one period of 2½ hours per day show a heavier stomach than do similar rats fed *ad libitum*.

5. Increased or decreased size in one part of the gastro-intestinal tract does not necessarily involve the other parts of the tract in the same type of change.

6. In a closed-population rat stock considerable variation in organ size may occur in rats of the same live weight and being kept under the same environmental conditions.

7. Observations show that the laboratory rat feeds predominantly, but not exclusively, during evening and night hours but it changes to diurnal feeding readily if food is available only during diurnal hours. The longest observed period of voluntary abstinence from food was nine hours. In most rats this period was much shorter.

8. The analogy is drawn between the relative increase in organ size plus increased food consumption in young rats and the increased metabolic rate in the younger ages in man.

XUM

Acknowledgments

Our thanks are due to Mr. F. Summerfield, A.R.P.S., for preparing the photographs, to Mr. R. K. C. Walters, Miss J. MacKenzie, Mr. M. Vagg and Mr. J. Gardner for technical assistance, and to Miss M. Maskell and Miss A. Somerville for attending to the animals.

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ELASTIC CAPSULAR CONTENT OF THE ADRENAL GLAND OF THE SHEEP

By

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The adrenal gland of the sheep is encompassed by a capsule of considerable and varying thickness. In common with those of most other glands in the body, this capsule has a basic matrix of typically-staining connective tissue in which is embedded other elements such as vessels, nerves, cells, etc.

Apart from reticular fibres there are three other types of fibre present in this matrix. The preponderance of these varies tremendously, collagenous fibres, for instance, being the most numerous and muscle fibres being present only sparingly. Elastic or yellow fibres are the second most numerous type of connective tissue fibre present in the capsule of the adrenal. Most modern histology textbooks, when discussing the adrenal capsule, dismiss the presence of yellow fibres by stating that there are but a few embedded in the reticular network. Indeed, when attempting to demonstrate their presence in the capsule by the more usual techniques such as that of Verhoeff, where differentiation of the connective tissue is gauged by the depth of staining of the elastic tunics of any arteries that happen to be present, very few yellow fibres do in fact retain the stain; and those that do, do so only by virtue of their size.

If, however, the times of differentiation are critically altered, in effect to 'overstain' any elastin that may be present, very many more fibres become obvious which would otherwise have been decolourised during normal differentiation. Thus by

PLATE 1

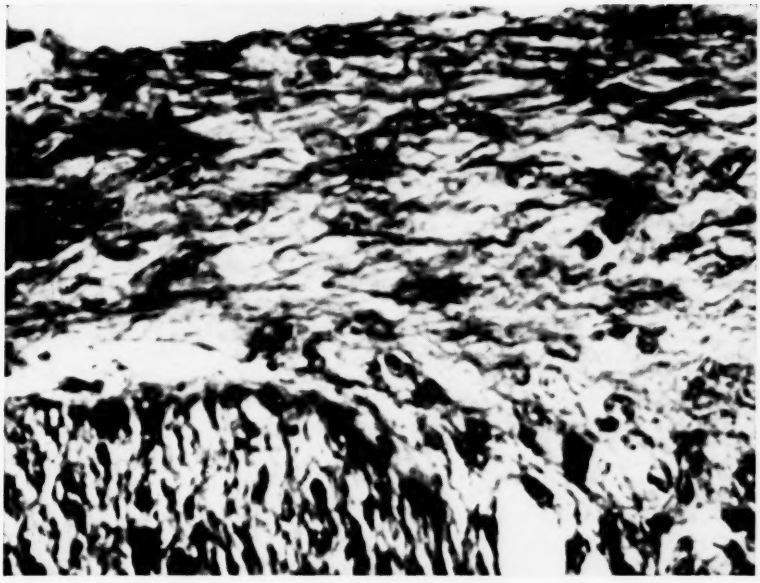

FIG. 1
Capsule of Soay Sheep adrenal stained with Verhoeff's technique x 1025.

FIG. 2
Capsule of Scotch Blackface adrenal stained with Orcein x 1500.

(Article by W. M. Stokoe, pages 234, 235)

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varying the times in Verhoeff's and the Orcein techniques, study under oil reveals that in addition to the scant "large" elastic fibres seen normally, there is an abundance of extremely fine fibres in the outermost layers of the adrenal capsule of sheep (Figs. I and II).

Discussion

One method by which cellular replacement occurs in the adrenal gland of the sheep, is by the organisation into nodules of undifferentiated mesenchymal cells within the glandular capsule, the eventual centripetal migration of these nodules, and their final fusion with the cortex (Stokoe, 1958).

That these hitherto unreported elastic fibres play a part in this centripetal migration of capsular nodules is most probable. The fact that they are so fine as compared with the stouter fibres seen normally in the adrenal capsule and in other organs, is quite tenable when one considers that, in general, yellow fibres are present in organs which require a certain amount of resilience, viz. the mammary gland, epiglottis, lung, etc.

In these organs the amount of 'contractability' required is far in excess of that ever needed in the adrenal; also, in the case of the latter organ, the fine meshwork of yellow fibres would tend to distribute an even pressure over the whole surface of the gland.

This evenly distributed capsular pressure must necessarily set up a centripetal pressure gradient. If one examines the question more critically, however, it becomes apparent that the role played by these capsular fibres is hardly one of straightforward compression, for it is difficult to visualise the adrenal gland as being subject to a constant capsular pressure throughout life.

It is more logical to think of these yellow capsular fibres as normally being relaxed and yet with the ability to use their reserves of resilience in much the same way as a punching-ball bounds back after being struck.

The formation of a nodule must initially cause some evagination of the capsule with associated tension of the capsular elastic fibres. A dialectal follow-up to this (hyperplastic nodules similar to those found in the horse by Speed and Morris (1946), excepted, where the continued proliferation of cells would stretch the fibres beyond the 'point of no return') is that a stage is reached when the fibres react like the punching-ball and bound back to 'punch' the nodular cells into the cortex.

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EFFECT OF VITAMIN A DEFICIENCY ON THE TESTES OF RAMS

By

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The effect of vitamin A deficiency on the male germinal epithelium and on reproduction in the female rat has been noted by a number of workers.

Wolbach and Howe (1925) reported that oedema of the testes during atrophy of the seminiferous tubules reached an extreme degree in rats, kept on vitamin A deficient diet. Mason (1925) has reported testicular degeneration in albino rats fed a purified ration.

Erb *et al.* (1947) studied the effect of sub-optimal intake of vitamin A upon reproduction in the ox in order to determine whether or not pre-pubertal vitamin A deficiency results in permanent impairment of reproductive processes which cannot be overcome by vitamin A therapy. They reported that sexual maturity was delayed, libido inhibited and spermatogenesis was reduced. They also reported that although moderate prepubertal vitamin A deficiency did not completely inhibit sperm production, fertility and reproductive capacity appeared to be seriously impaired since sexual drive and spermatogensis were reduced. They also alluded to the possibility that prepubertal damage may be permanent especially when severe and widespread. Madson *et al* (1942) and Hodgson *et al* (1946) have reported that local damage to germinal tissues of the testis due to vitamin A deficiency is repairable.

Lindley *et al.* (1949) in their experiment on the effect of vitamin A deficiency on semen quality, and effect of testosterone and pregnant mare serum on rams, reported degeneration of the germinal epithelium. The present paper deals with the sexual behaviour and histopathological changes in the testes of young growing rams kept on vitamin A deficient diet.

Material and Methods

Six rams, born of dams kept on a diet inadequate in vitamin A, were used for studying sexual behaviour and histopathological changes in their testes in vitamin A deficiency. A similar number born of dams kept on an adequate diet of green food were used as control. The experimental feeding was done in two stages. It was felt that if the weaned lambs were put immediately on a very low intake of carotene, they might not survive for long, so they were given carotene to maintain them for a time and then switched on to low carotene intake. After about six months of feeding on low carotene intake, the lambs began to exhibit symptoms of vitamin A deficiency. The rams continued to take the diet according to their body weight and thus never suffered from inanition.

Three of the Vitamin A deficient rams died after about a year and the other three were destroyed when they were in moribund condition. Testes were collected, weighed and fixed in 10 per cent formol saline. Sections 5-6μ thick were cut and stained by haematoxylin and eosin.

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PLATE 1

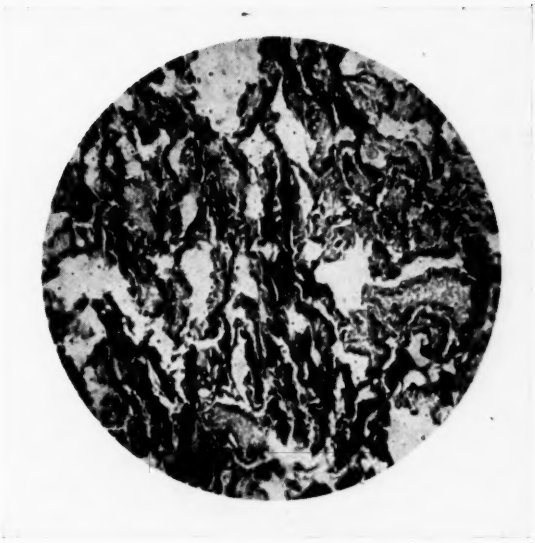

FIG. 1

Testis from a Vitamin A deficient ram showing collapsed tubules containing necrosed and degenerated material. Haematoxylin and Eosin x 100.

FIG. 2

Testis from a normal control ram showing different layers of cells and spermatogenesis. Haematoxylin and Eosin x 100.

(Article by B. Dutt, pages 236, 237, 238)

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Results

The earliest sign observed, as in the case of other species, was night blindness. There was marked opacity of cornea in all the vitamin A deficient rams. Xerophthalamia was not observed in any lamb. The yield of wool as well as the length of the fibre in vitamin A deficient lambs was less than half of that in the control. Inco-ordination in gait and muscular weakness was observed in the lambs . The testis of the rams were much smaller in size and weight than those of the control group due to their retarded growth. The weight of the testes of a normal ram was about 7-10 times the weight of testes of the vitamin A deficient ram. The weight of the testes of the vitamin A deficient rams ranged between 24.85 g. to 33.30 g. as compared with 26.20 g. in the controls. The average weight of vitamin A deficient lambs was about 30 lb. as compared with the 60 lb. of the control lambs.

There was a marked decrease in sexual desire and with the onset of deficiency symptoms, rams showed little inclination to mount. Libido continued to decline until little or no sexual interest could be aroused after the rams had been on carotene deficient diet for ten months. At this stage, the scrotums of the deficient animals were greatly retracted as compared with those of the controls.

Histopathological Changes

Histopathological changes observed in the testes of all the deficient lambs were more or less similar to those described by Lindley *et al.* (1949) in the testes in their experiment on the effect of vitamin A deficiency on semen quality and the effect of testosterone and pregnant mare serum on rams.

The diameter of the seminiferous tubules of the vitamin A deficient rams was reduced considerably (fig. 1) as compared with those of the controls (fig. 2). The cells lining the seminiferous tubules showed marked degenerative changes. Most of the seminiferous tubules were almost completely collapsed and most of the tubules were lined by a single layer of cells. Only basal cells derived from sertoli cells remained. In some of the tubules, giant cells formed by the fusion of cells could be seen. These giant cells on further destruction formed the structureless material. The giant cells were big in size and the nuclei and cytoplasm was stained densely. Virtually there was a complete cessation of spermatogenesis.

Morphological alterations also occur in the testis due to inanition. Mason (1935) reported that in vitamin A deficiency atrophy of the germinal epithelium occurred more rapidly than in inanition. The difference is apparently one of degree since atrophy of the testis occurs in vitamin A deficiency and inanition.

Summary

Young rams born of dams kept on sub-adequate vitamin A diet were put on experimental diet which contained only traces of vitamin A. After a month, symptoms of vitamin A deficiency began to appear. The testes were atrophied to a considerable degree and the weight of the organs of normal rams was about 7-10 times the weight of those of the vitamin A deficient ram. Vitamin A deficient rams exhibited very

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little of sexual desire and libido continued to decline until after ten months of feeding on carotene deficient diet, little or no sexual interest could be aroused. The seminiferous tubules of the vitamin A deficient rams showed degenerative changes on histopathological examination. The diameter of the tubules was reduced considerably and most of the tubules were lined by a single layer of cells. The lumen of the tubules was full of structureless necrotic material and there was no sign of spermatogenesis.

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THE DETERMINATION OF THE CARBON DIOXIDE CONTENT OF BLOOD AND PLASMA BY MEANS OF CONWAY UNITS

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The methods in general use for the determination of the carbon dioxide content of blood and plasma are the gasometric methods of Van Slyke:

(a) The Volumetric Method (Van Slyke, 1917).
(b) The Manometric Method (Van Slyke and Neil, 1924).

Other methods have also been devised to determine the CO_2 content or the bicarbonate concentration of blood and plasma (Christiensen *et al.*, 1940; Segal, 1955; Van Slyke, 1922; Nadeau, 1953).

Of all these methods, the Manometric Method of Van Slyke has been used to the greatest extent and is the standard against which other methods are compared. In use there are several disadvantages:

(a) For accuracy skilled technical assistance is required.
(b) The number of determinations possible in one day is limited.
(c) The initial cost of the manometric apparatus is high.
(d) Breakages of various parts of the apparatus occur at the most inopportune moments.

Edward J. Conway has developed the Conway unit for the determination of many volatile substances present in biological fluids (Conway, 1957). Carbon dioxide is one of the many substances for which he gives a method but there are few reports in the literature (Lehmann, 1944) of the use of the method to determine the carbon dioxide content of blood and plasma.

The method has been used in this laboratory for two years and this communication gives details of our experience.

Principle of the Method

In a gas-tight Conway unit the carbon dioxide present in blood or plasma is released by means of a strong mineral acid. The carbon dioxide diffuses into the centre well where it is fixed by means of a solution of barium hydroxide. The excess barium hydroxide is determined by titration with dilute hydrochloric acid. By calculation, knowing the strength and volume of barium hydroxide, the concentration of carbon dioxide can be found.

Reagents

(1) A saturated solution of barium hydroxide. This stock solution is kept in a sealed bottle. (2) A solution of N/2 sulphuric acid. (3) An indicator solution of a mixture of phenolpthalein and thymolpthalein in alcohol. (4) A solution of hyrochloric acid made up accurately to be of N/80 strength. (5) Seal for the Conway units. This consists of a mixture of 6 gm. of gum tragacanth, 100 ml. of water, 50 ml. of glycerol and 10 ml. of N/2 sulphuric acid. (6) From the stock solution of barium hydroxide a working solution is made up. This solution consists of a mixture of saturated barium hydroxide, distilled water and mixed indicator solution. The strength of the solution is adjusted so that 1 ml. requires 4-4.5 ml. of N/80 hydrochloric acid to change its colour from purple through pink to colourless. Once made up, this solution is stored in a CO_2 free atmosphere.

Apparatus

(1) A number of No. 1 Conway units.

(2) Syringe pipettes of the " walking stick " pattern. In two sizes delivering 0.5 ml. and 1.0 ml., respectively.

(3) One 5 ml. micro-burette.

(4) A magnetic stirrer.

(5) A transparent shield behind which the Conway units can be titrated.

Method

(1) Setting up the Conway units (fig. 1).

(a) The ground glass lids and rims of the Conway units are smeared with the sealing compound.

(b) Step 1. 0.5 ml. of N/2 sulphuric acid is delivered into the outer well of each Conway unit at a point diametrically opposite to the point where the plasma is to be added.

(c) The lids are then placed on the Conway units having about one-half of the inner well uncovered.

(d) Step 2. By means of a syringe pipette, 1.0 ml. of the working solution of barium hydroxide and indicator is delivered to the centre well of each unit and the units are immediately sealed.

(2) Step 3. A number of Conway units are set up. Some are left like this to act as blanks. In this manner the slow deterioration of the barium hydroxide solution even in the CO_2 free storage system is allowed for.

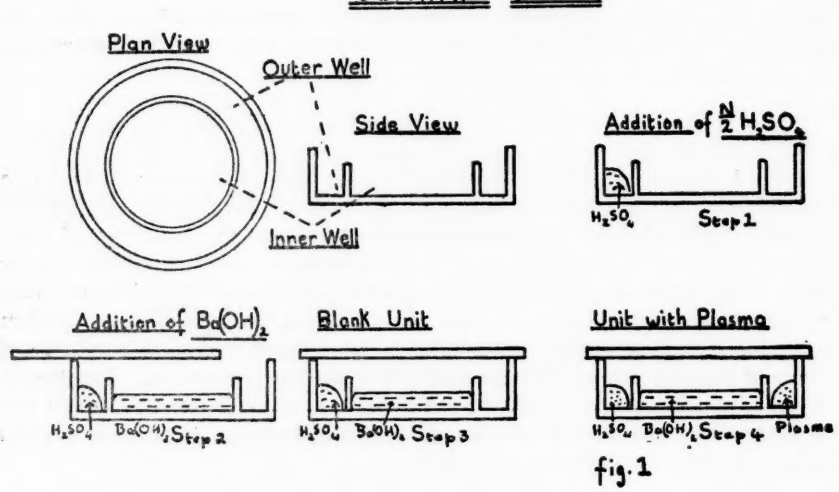

fig. 1

(3) Addition of plasma or blood.

(a) Plasma or blood removed from the subject with suitable anaerobic precautions (Davenport, 1950) is taken into a 0.5 ml, syringe pipette.

(b) The lid of the Conway unit is moved over a small amount and the plasma is delivered into the outer well.

(c) Step 4. The unit is sealed immediately.

(d) The unit is then rotated slightly to bring the acid into contact with the blood or plasma.

(e) The units are then left on the bench at room temperature for at least 12 hours (overnight) and sometimes for as long as 48 hours.

(4) Titration.

Titration of the excess barium hydroxide is carried out using N/80 hydrochloric acid in the micro-burette. A magnetic stirrer is used for mixing during titration. Titration is carried out behind the transparent screen so that the operator does not breathe on the open Conway unit during titration. The end point is signalled by a change in colour from purple to pink and then the final colour change is pink to colourless.

(a) Blank units are titrated first to determine the amount of barium hydroxide (B) present in each unit before the addition of carbon dioxide from blood or plasma.

(b) Units containing blood or plasma are then titrated to determine the amount of acid (U) required to neutralise the barium hydroxide left after the absorption of the carbon dioxide released from 0.5 ml. of plasma or blood.

Calculation

(i) $Ba(OH)_2 + CO_2$
(ii) $Ba(OH)_2 + 2HCl$

Blank reading (B) gives the amount of $Ba(OH)_2$ present in solution initially. Unknown reading (U) gives the amount of $Ba(OH)_2$ left after absorbing CO_2.

Therefore (B—U) gives the amount of barium hydroxide required by CO_2, but from (i)

1 m/mole $Ba(OH)_2$ absorbs 1 m/mole CO_2

and from (ii)

1 m/mole $Ba(OH)_2$ requires 2 m/moles HCl for neutralisation.

Therefore 1 m/mole CO_2 is equivalent to 2 m/moles HCl.

But the strength of acid used was N/80 and the volume of blood or plasma 0.5 ml.

Therefore the number of m/moles of CO_2 in 0.5 ml. of blood or plasma

$$=\frac{(B—U)}{2} \times \frac{1{,}000}{80} \times \frac{1}{1{,}000}$$

Therefore number of milli/moles CO_2 per litre of plasma

$$=\frac{(B—U)}{2} \times \frac{1{,}000}{80} \times \frac{2{,}000}{1{,}000}$$

$$=(B—U)\ \frac{100}{8}$$

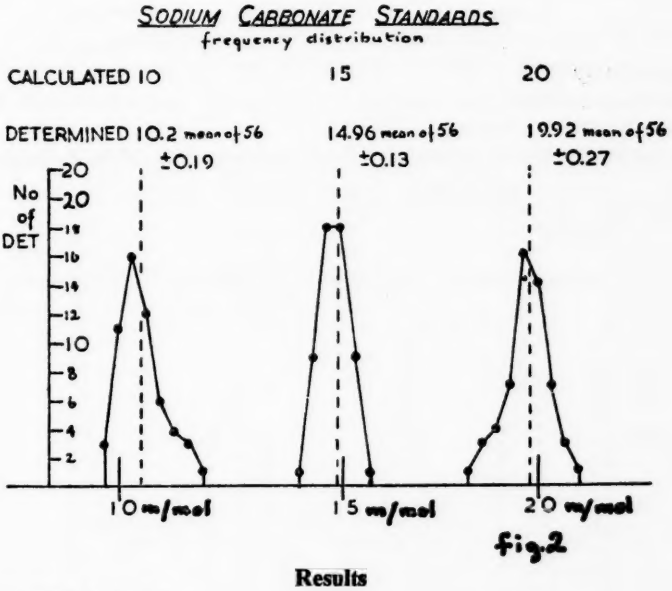

fig.2

Results

(1) *Standard Solutions.*

A number of standard solutions of sodium carbonate containing 10, 15, 20, 25, 30 and 35 m/moles per litre of carbon dioxide were freshly prepared and determin-

ations were made of the carbon dioxide content of these solutions. The figures below (figs. 2 and 3) illustrate the recovery obtained by means of frequency distribution curves.

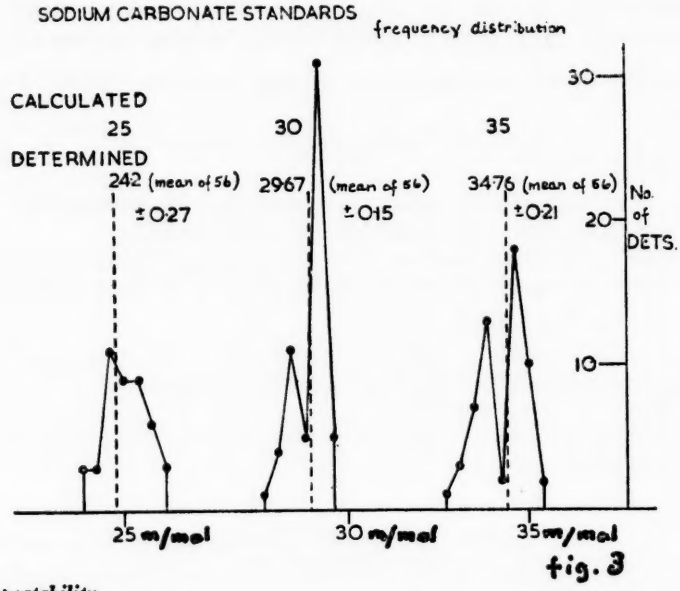

fig. 3

(2) *Repeatability*

Four plasma samples were obtained from dairy cows and a number of determinations were made on each sample.

Frequency distribution curves were drawn and are given below in figure 4.

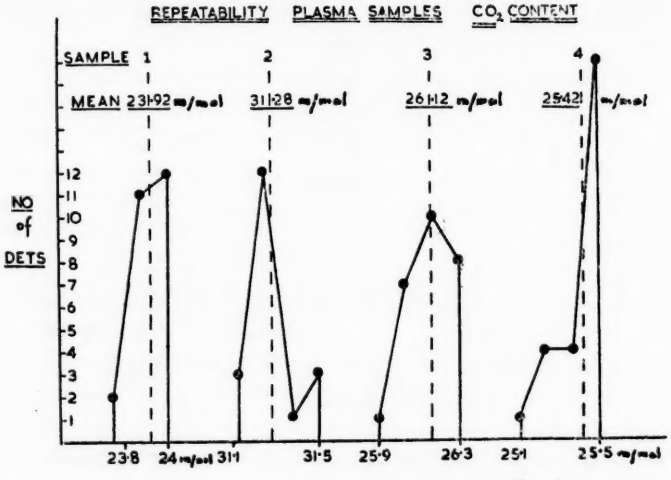

fig. 4

Discussion

The Conway method has been in use in this laboratory for two years and has been found to possess certain advantages over the classic Van Slyke methods.

(a) The number of determinations possible at one time is limited only by the number of Conway units available.

(b) Once set up, the individual Conway units can be left for some time before completing the final titration.

(c) The final titration is a simple acid-base titration well within the competence of the majority of laboratory workers.

(d) Stock solutions can be made up some time prior to the actual determination and do not require vacuum extraction of dissolved gases before use.

A direct comparison has not been made by the author with the manometric method of Van Slyke. The mean value, 27.5 m/mole/litre, obtained for the carbon dioxide content of the plasma of 47 dairy cows using the Conway method is similar to the mean value obtained previously using the Van Slyke apparatus (26.9 m/mole per litre for the total CO_2 content of the plasma of 141 dairy cows).

A direct comparison of the Conway method and the manometric method of Van Slyke has been carried out by Lehmann (1944).

Acknowledgement

I would like to acknowledge the skilled technical assistance given by Miss Helen Peden in the development and use of this method in this laboratory.

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XUM

THE CARBON DIOXIDE CONTENT OF THE PLASMA OF DAIRY COWS AND CALVES

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Gamble (1954) has described the plasma bicarbonate as occupying the mendicant position of the plasma anions in that its concentration may be easily altered to accommodate excesses or deficiencies of the other plasma anions. Plasma bicarbonate cannot be determined directly with any degree of accuracy; however the plasma bicarbonate may be obtained from a knowledge of the total carbon dioxide content of the plasma, the plasma pH or the partial pressure of carbon dioxide in plasma and calculation from the modification of the Henderson-Hasselbach equation (Davenport, 1950)

$$pH = pk + \log \frac{\text{Total } CO_2 - pCO_2}{pCO_2}$$

From a knowledge of the plasma bicarbonate concentration and the plasma pH, an indication may be obtained of the acid-base balance of an animal and the nature of any disturbance of acid base balance may usually be found (i.e. whether the disturbance is primarily respiratory or metabolic).

Veterinary literature contains many references to the determination of the carbon dioxide content of bovine plasma (Anderson *et al.*, 1930; Bianca 1952; Craige, 1947; Craige *et al.*, 1949; Dale *et al.*, 1954; Dennis and Harbaugh, 1946; Duncan *et al.*, 1953; Krapf, 1941; McSherry *et al.*, 1954; Sampson, 1935).

The values given are all for plasma derived from venous blood with the exception of the values of McSherry *et al.* which are for venous serum.

Davenport (1950) discussing similar determinations made on plasma from the human subject stated that such plasma should be obtained from arterial or arterialised blood.

The present communication records the carbon dioxide content of plasma obtained from the arterial blood of Ayrshire cattle. For the purposes of comparison some records of the total carbon dioxide content of the plasma obtained from venous blood of Ayrshire cattle are included.

Methods

(i) *Animals*

The adult subjects from which the blood samples were obtained were healthy dairy cows in various stages of pregnancy and lactation. The calves were aged between seven days and three months and, like the adults, were normal and healthy.

(ii) *Blood samples*

All blood samples were withdrawn from the animals without stasis and under strict anaerobic conditions. They were collected, under mineral oil, into heparinised centrifuge tubes. Sufficient blood was collected into each tube to displace most of the protective layer of oil. The tubes were sealed with a soft rubber bung so that all contact of the collected sample with air was excluded.

(a) Venous blood samples were withdrawn from either the jugular or the mammary vein.

(b) Arterial blood samples were obtained by direct puncture of the brachial artery (Fisher, 1956).

The blood samples were collected from adult cows immediately after the morning milking, dry cows present in the byre being sampled at the same time. Blood samples were collected from the calves after their morning feed. Once the blood samples had been obtained, they were centrifuged as soon as possible and then the determinations were made.

Duplicate samples were taken from each animal and initially duplicate determinations of each sample were made. After a time it was not considered necessary to make so many individual determinations and finally single determinations only were made on the duplicate tubes.

(iii) *Biochemical methods*

Two methods were used for the determination of the carbon dioxide content of plasma.

(a) The manometric method of Van Slyke (Peters and Van Slyke, 1946).

(b) The method of Conway (Conway, 1950).

Results

The results obtained for the total carbon dioxide content of the plasma of Ayrshire cows and calves are given in Table I.

TABLE I

Animals	No.	*Samples*	CO_2 *Content m/mole/litre*	*Range*
Adult Cows	24	Venous Jugular	28.2 ± 2.3	23.8–34.5
Adult Cows	141	Arterial Brachial	26.9 ± 2.8	22.3–32
Lactating Cows	126	Arterial Brachial	27.0 ± 2.1	22.8–31
Dry Cows	15	Arterial Brachial	26.7 ± 1.71	24–30
Pregnant Cows	65	Arterial Brachial	26.6 ± 1.73	22.8–31
Non-Pregnant Cows	76	Arterial Brachial	27.3 ± 2.16	22.8–32
Calves 7 days — 3 months of age	65	Arterial Brachial	28.7 ± 3.24	20.8–34.5

For the purposes of comparison the 141 results obtained for the total carbon dioxide content of arterial plasma have been subdivided in the table into pregnant and non-pregnant, lactating and dry cows. No significant difference is detectable

between them. The arterio-venous difference found in Ayrshire cows, 1.3 m./mole/litre, is similar to that described for man of 1.1 m./mole/litre, (Davenport, 1950). The mean value for the calves, 28.7 m./moles/litre, is higher than the mean value for the adult cows and the range of normality is wider (20.8-34.5 m./mole/litre).

The results obtained of the total carbon dioxide content of all cows have been subdivided on a seasonal basis and the results are given in Table 2.

TABLE II

Season	*No. of Animals*	*Mean Total CO Content m/mole/litre*	*S.D.*
Spring	49	26.3	± 1.58
Summer	39	27.3	± 2.12
Autumn	10	27.6	± 2.12
Winter	50	27.8	± 2.1

No significant seasonal variation is observed.

Three cows were sampled at various times through the day and the results are given in Table 3.

TABLE III

Cow	*Date*	*Time*	*Arterial Plasma (m/mole/litre)*
A	16.5.58	13.25	27.3
		13.32	27.3
		13.35	27.9
		13.37	27.9
		13.40	27.9
		14.45	30.0
B	12.3.58	9.15	27.8
		10.15	27.8
		11.15	27.0
		12.15	27.3
		13.15	27.8
		14.15	27.8
		15.15	27.1
		16.15	27.0
C	7.1.58	10.00	29.8
		11.00	27.9
		12.00	29.8
		13.00	29.3
		14.00	30.0

The maximum variation observed, 1.7 m./mole/litre, is small and does not cover the range 22.3-31.2 m./mole/litre found for the 141 cows.

The variations in the total CO_2 content which occurred when blood samples were taken from different vessels of the same animal are illustrated in Table 4.

TABLE IV

Cow	*Sample*	*Vessel*	*Plasma CO_2 m/mole/litre*
10345	Venous	Jugular	30.5
		Mammary	32.5
	Arterial	Brachial	29.0
12652	Venous	Jugular	34.25
	Venous	Mammary	35.9
	Arterial	Brachial	33.1
12653	Venous	Jugular	30.1
	Venous	Mammary	31.5
	Arterial	Brachial	28.75
12686	Venous	Jugular	26.25
	Venous	Mammary	29.00
	Arterial	Brachial	26.00
12687	Venous	Jugular	30. 625
	Venous	Mammary	27.625
	Arterial	Brachial	25.00

The variation in the carbon dioxide content of arterial and venous samples is to be expected but marked differences, as much as 3 m./moles/litre, were detected between samples removed from jugular and mammary veins. These differences exceeded those observed in sampling at different times from the same vessel (Table 3).

Discussion

The mean value obtained for the total carbon dioxide content of the arterial plasma of Ayrshire cows, 26.9 m./moles/litre, is similar to that given for the mean value of the total carbon dioxide content of human arterial plasma, 27.2 m./moles/litre (Spector, 1958).

The mean value obtained for the total carbon dioxide content of venous plasma of Ayrshire cattle is similar to that obtained by other authors making determinations on cattle plasma.

Having previously determined the mean arterial plasma pH to be 7.43 (Fisher, 1959) it was possible to use the Henderson-Hasselbach equation to calculate the plasma bicarbonate of Ayrshire cows to be 25.8 m./moles/litre.

The marked variations observed in the carbon dioxide content of plasma, taken at the same time from different vessels of the same animal, emphasise the necessity for removing all blood samples from the same site if one is studying the changes in the plasma carbon dioxide during the course of an experiment.

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Summary

The total carbon dioxide content of the plasma obtained from arterial blood of Ayrshire cattle has been determined as 26.9 m./moles/litre ± 2.8 with a range of 22.3 - 32. Variations due to lactation, pregnancy and season have not been observed. The total CO_2 content of the arterial plasma of Ayrshire calves has been determined as 28.7 m./moles/litre ± 3.24 with a range of 20.8 - 34.5. Diurnal variations have been studied and so have variations occurring in the individual animal when blood samples are obtained from different vessels.

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THE TREATMENT OF THE TRANSMISSABLE VENEREAL TUMOUR WITH PODOPHYLLIN RESIN

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The transmissable venereal tumour has a widespread geographical distribution, and is mentioned in *Black's Veterinary Dictionary* as occurring in Great Britain, the United States of America, and parts of South Africa, and as being comparatively common in some parts of India (Miller 1939). According to our records it occurs quite commonly in Uganda.

In spite of its general and common occurrence the references to this condition are scant. Surgical excision of the venereal tumour in the dog is described by O'Connor (1956). He states that successive operations at intervals of a week may be necessary and also treatment with silver nitrate. Kirk (1954) quotes Culp *et al.* (1944) as treating condylomata accuminata with podophyllin in oil. Transmissible venereal tumour is mentioned in *Canine Medicine* (1953) but no treatment is suggested, although treatment of warts (verruca; verruca vulgaris; infectious papillomatosis) with 25 per cent. podophyllin in mineral oil is advised. Paint of podophyllin (25%) is mentioned as a treatment of warts in the *British Veterinary Codex*, 1953.

Since writing the draft of this communication we have been interested to read in the *Veterinary Record* of February 7th 1959, that podophyllin paint is advised for the treatment of venereal granulomata, (Woodrow 1959). In view of this communication we are not presenting our detailed series of case histories as originally intended, but we believe that a general note of our experiences with this resin is not out of place.

The tumour is described by Gaiger & Davies (1947) as resembling, histologically, a round-celled sarcoma. Raven (1958) describes transmissible venereal tumour of dogs as the only one in animals in which transmission occurs by viable cells from one surface to another. He describes the tumour as occurring in dogs all over the world, and with no special predisposition for any particular breed. He describes the tumour cells as being uniformly "large, round or slightly oval, with large vesicular nuclei, and abundant, clear, or faintly granular cytoplasm." He mentions that this tumour bears no relation to human venereal warts and cites Bloom *et al.* (1951), who regard this tumour as being of reticulo-endothelial origin and support the designation "Transmissible venereal tumour."

Treatment of condylomata accuminata in the human by podophyllin was reported by Kaplan (1942), who noted rapid involution as a result, and by Sullivan (1947), who described striking effects on mitosis, which he likened to the effects produced by colchicine. The contra-indications mentioned by Raven to this treatment are probably not applicable to its use in the treatment of transmissible venereal tumour in the dog.

Surgical excision in the male dog usually presents no difficulties, although cases treated surgically elsewhere have been presented to us for treatment of subsequent scar contraction of the urethra. A number of cases were passed on to us about six months ago of transmissible venereal tumour in the bitch involving the urethral orifice. As surgical correction of these would have been extremely delicate and difficult as well

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as hazardous, we decided to try 10 per cent. suspension of podophyllin in liquid paraffin (Liq. Paraff., B.P.)

This treatment was most successful. In some cases the tumours disappeared after only three or four applications. In six cases there were two recurrences; in one of them another tumour was found in the region of the cervix, and a longer tube was given to the owner for application of the suspension, after which all signs of the condition disappeared. The second case was particularly interesting owing to the extraordinary size of the lesion. The dog in question (Ridgeback, female adult) was acquired from the dog pound. In December, 1958, a growth was reported to have formed which was clearly visible at the vulval orifice as a somewhat globular mass nearly two inches in diameter. Palpation was not easy as the tumour completely occluded the lumen of the vagina. A polythene tube was passed beyond the growth and 3 ml. of 10 per cent. suspension of podophyllin passed through the tube into the vagina. This was repeated five days later and the growth apparently disappeared. For various reasons this animal was not examined properly until the end of March, when a small (query) regrowth was noted.

One male dog was also treated in this way. The granuloma was situated high up at the juncture of the penis with the prepuce. Two ml. of the suspension were placed deeply in the prepuce and this procedure was repeated a further four times by the owner at approximately four day intervals. Examination after three weeks showed no traces of the growth. This case may indicate that conservative treatment in the male dog may have advantages also.

As we did not submit material for pathological examination our experiences cannot be regarded as conclusive. All we can say is that by the use of this method we managed to prolong happily the lives of a number of dogs which would otherwise have been destroyed or at the best subjected to extensive surgical interference. We do not suggest that the 10 per cent. suspension we have used has any advantage over the more concentrated suspension.

Summary

The treatment of transmissible venereal tumour with podophyllin suspension is described.

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BRUCELLOSIS IN MALTA. II.*

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Trials with a Living Attenuated Brucella melitensis Vaccine in Goats.

In recent years numerous vaccines for the immunization of goats against *Br. melitensis* infection have been tried experimentally in various parts of the world. Three vaccines were used in a comparative experiment in Tunis (Renoux *et al.* 1957). The most promising appeared to be an adjuvant vaccine prepared from a killed smooth strain of *Br. melitensis*. Work carried out in guinea pigs (Jones and Alton 1956) suggested that a killed rough strain of *Br. melitensis* in adjuvants would produce the same degree of immunity as a similar vaccine made from a smooth strain, but would have the advantage of not inducing agglutinins. An attenuated living vaccine has been developed recently at the University of California (Elberg and Faunce 1957).

In order to determine which of these three vaccines was the most efficient, an experiment was carried out in goats at the Veterinary Laboratory of the Ministry of Agriculture, Fisheries and Food, Weybridge (Jones, Thomson and Alton 1958). Results seemed to indicate that the living attenuated vaccine of Elberg and Faunce produced the strongest immunity. This vaccine is prepared from a non-dependant reverse mutant selected from a population of streptomycin dependant *Br. melitensis* organisms.

It was felt that these results justified an experiment under natural conditions in Malta using Elberg's vaccine; this experiment is described in this paper. The general plan of the experiment was to vaccinate one group of kids, and one group of lactating goats of various ages, the latter being housed along with a similar group of non-vaccinated controls. Mating was begun about one month after vaccination was carried out and all the animals were exposed to natural infection by the introduction of known infected pregnant goats into the herd in the later half of the pregnancies of the experimental animals. As many cultures as possible were made from the experimental animals, especially at kidding. Some time after parturition the animals were destroyed. Each goat was examined post-mortem and material for culture was procured.

Materials and Methods

Goats: All goats used were of the local Maltese breed. 18 female kids were purchased from one herd. These were all negative to the serum agglutination test at seven successive weekly tests before vaccination. Three batches of adult female goats were purchased from the same and one other herd. Some of these were found on arrival at the laboratory, to be reactors and were discarded. Weekly blood tests were carried out on the three groups for 11, 9, and 4 weeks respectively, before the vaccinations. Only one reacting animal was detected after the original tests. At the autopsy it was noted that this goat had a slight generalised infection. These adult females were divided into vaccine and control groups. At a later stage more goats were obtained from the sister island of Gozo. They came from two herds believed to be brucellosis-free and all were serologically negative on arrival at the laboratory. These goats were used as infected " donors " and additional controls over the challenge period.

* Article I appeared on page 96 in the MARCH 1959 issue of this journal.

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Vaccine and Control Groups: Group 1; 18 female kids were vaccinated at 4-7 months of age.

Group 2; 18 adults from those purchased, were grouped for vaccination.
Group 3; the remaining 17 adult females which corresponded closely to those in group 2 regarding age, origin, and milking state, were grouped as controls. Two goats from this group were slaughtered between the time of vaccination and challenge. The first developed an agglutination titre of 1/40, was slaughtered and was found negative at autopsy. The second, not known to be pregnant, aborted a single foetus. This goat, the aborted foetus and the foetal membranes were negative on autopsy and culture. Thus, the control group was reduced to 15, but at the time of challenge, this number was made up to 22 by the addition of seven pregnant goats from among those purchased in Gozo.

Housing: Group 1 was housed in a concrete-floored house with a small outdoor part; about ¼ mile from groups 2 and 3. Groups 2 and 3 were housed in two large concrete goat houses with a common concreted run. After vaccination 9 vaccinated slept in each house with 8 controls in one house and 9 in the other.

After challenge by the introduction of infected donor animals, all animals in the experiment were mixed in one herd, and housed together in the two large concrete houses already mentioned. From this time until the end of the experiment, grazing on waste land was allowed for the whole herd for a few hours each day.

Vaccination: Vaccine packed in ice and shipped by air was supplied by the University of California. Group 1 was vaccinated on 5 August 1957 with vaccine received on the previous day. One ml. of suitably diluted vaccine was given subcutaneously over the ribs, to each goat. A viable count on the diluted vaccine at the time of vaccination indicated that 1 ml. contained 2×10^9 organisms. The 18 goats in group 2 were vaccinated in similar manner on 3 September 1957 with vaccine which arrived on the previous day. The viable count was 2.8×10^9 organisms per ml.

Mating: All groups were mated to the same billy goat, which had been found negative to repeated sero-agglutination tests. Mating ceased on 31 December 1957.

Mating of group 1 commenced on 14 September—approximately 6 weeks after the vaccination. Two animals in this group failed to conceive. Mating of groups 2 and 3 commenced on 3 October—approximately 4 weeks after vaccination. Two goats from group 2 and three from group 3 failed to conceive.

Challenge of immunity: Four negative pregnant donor goats were each artificially infected with approximately 5×10^9 *Brucella melitensis* organisms on 19 December 1957, and were added to the main herd on that date. It was arranged that two of these donor animals should sleep in each house. During the day the whole herd ran together.

The infecting strain of *Br. melitensis* had been isolated from the spleen of a goat slaughtered at the local abattoir on 6 December 1957. The second subculture from this isolation was used to infect the donors. This strain was typically *Br. melitensis* as regards lack of CO_2 requirement for growth, H_2S production, growth on thionine and basic fuchsin, and serology.

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One donor goat aborted on 8 January, two on 9 January and the fourth on 16 January 1958. Typical *Br. melitensis* organisms were isolated in large numbers from the foetuses, membranes, vaginal discharges and milk of all these donors.

Of a second batch of donor goats each animal was infected with approximately 15 x 10^9 organisms of the strain of *Br. melitensis* used for infecting the first four donors, on 8 February, and introduced into the main herd on the same day. One of these goats died from pregnancy toxaemia, a second was subsequently found to be affected with hydrops amnii, and the other two aborted on 3 March and 21 March respectively. Again, heavy elimination of typical *Br. melitensis* cells was demonstrated following these abortions.

As from the date of introduction of infected animals the floors of the pens were not washed down, but merely swept once a day. Foetal membranes, after being removed for culture work were returned to the goat house and left lying on the floor until the next sweeping.

Diagnostic and Cultural Procedures: Following vaccination, rectal temperatures were recorded daily for 26 days in the goats of group 1 and 29 days in the vaccinated group 2. The weight of each goat was recorded once weekly from the time of its arrival at the laboratory until several weeks after vaccination. Milk yield was recorded once a week throughout the experiment.

Milk Culture: Before vaccination, milk samples were cultured once weekly: after vaccination, this was changed to twice weekly for one month, then once weekly until the infected goats were introduced, and from this point up to the end of the experiment, twice a week. Milk samples were taken into one ounce bottles; they were held in the refrigerator for 24 hours, then three loopfuls of cream and three loopfuls of deposit were spread an albimi agar plates containing antibiotics (the medium of Kuzdas and Morse 1953 as modified by Renoux 1954). This medium was used throughout the experiment and is hereafter referred to as albimi antibiotic agar.

Agglutination Tests: Each goat was bled once a week throughout the experiment and agglutination tests were carried out on each sample, using the antigen received from the Veterinary Laboratory of the Ministry of Agriculture, Fisheries and Food, Weybridge. Using this antigen, when the titre (50% agglutination) is 1/40 the serum under test may be considered to contain 80 international agglutination units per ml. 5% saline solution was used both in diluting the antigen concentrate and in making the serum dilutions.

Stained Antigen Test on Milk: This test was carried out once weekly throughout the experiment on milk from goats which were lactating. Two drops of brucella ring test antigen (haematoxylin stained) were added to one ml. of milk in a narrow tube, and the tubes incubated in a bacteriological incubator. Readings were made after 1 and 6 hours' incubation. Results were evaluated according to the amount of deposit which collected at the bottom of the tubes.

Cultural Procedures at kidding: (a) Foetal Membranes; collected from the goat house by the attendant and placed in an enamel basin which had been disinfected chemically. At first, the attendant had used his hands to pick up the membranes; later a pair of flame-sterilized tongs was provided. Two cotyledons from different parts of each

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membrane were sliced and rubbed over albimi antibiotic plates after being washed in three changes of sterile saline solution. (b) Vaginal swabs; cultured on albimi antibiotic agar daily for seven days after kidding.

(c) Kids: autopsied and cultured within 24 hours of birth. The following lymph nodes and tissues from each kid were cultured by slicing with scissors and smearing over the surface of albimi antibiotic agar—parotid, submaxillary, retropharyngeal, suprascapular, precrural, supramammary, hepatic, mesenteric, iliac, and mediastinal lymph nodes, testes or mammary glands, liver, uterus, kidney, spleen and lung. In aborted foetuses stomach contents also were cultured.

Autopsy of Goats: Goats which died of intercurrent disease were autopsied immediately after death. Slaughter and autopsy of the others began on the 7 April i.e. three months after the first kidding amongst the vaccinated and controls. Goats which had kidded first were autopsied first, but in the order of one from group 1, one from group 2 and one from group 3 and so on. Thus, each group was exposed to infection for approximately a similar period before slaughter. By 25 April all the goats had been autopsied except four controls from group 3: they kidded later than the others and were autopsied about one week after they kidded. The following lymph nodes and tissues were taken from each goat at autopsy, sliced with scissors, and smeared on albimi antibiotic agar; parotid, submaxillary, atlantal, retropharyngeal, suprascapular, precrural, supramammary, hepatic, iliac and mediastinal lymph nodes, and spleen, liver, uterus, mammary gland and lung.

Examination of Cultures and Identification of Organisms: Plates were examined after 4 and 10 days incubation.

Brucella melitensis recovered at any stage throughout the experiment was identified by slide agglutination against specific *Br. abortus* and *Br. melitensis* sera. The vaccine strain was distinguished from the virulent strain by growth on basic fushsin 1: 50,000 and thionine 1: 80,000 and development of colony size on glycerin dextrose agar.
Deaths: No deaths occurred from the beginning of this experiment up to mid-February 1958. After this time 10 goats from groups 2 and 3 (5 vaccinated and 5 controls) died either from pregnancy toxaemia during the later stages of pregnancy or from metritis immediately after parturition.

Results

Local and Systemic Reactions: There was no visible change in general health of the goats following vaccination, but in the case of those vaccinated as kids, there was some loss of appetite on the third day after vaccination.

Local reactions showed as flat, hot, rather painful plaques about 3″ in diameter, noticeable first between the second and fourth days, and accompanied in many cases by an oedematous ridge on the lower part of the thorax. Four days later the local swellings had become firmer and less painful and by 2½ weeks nothing was evident other than, in a few cases, a small bean-sized non-painful nodule. At the time of autopsy, nothing could be found except in a few cases, when a pea-sized dry purulent nodule, resulting presumably from extraneous organisms, was present.

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Temperature reactions in kids were evident 1-4 days after vaccination, the temperature usually reaching 105° or 106°F., in one kid it rose to 107.8°F. The rise in temperature generally persisted for 4 to 7 days. In vaccinated kids, there was a slight check in weight gain but no change in body weight was recorded in adults. Temperature reactions in the vaccinated adults were less marked (maximum recorded 105.6°F.), and in four goats were entirely absent. The milk yield of lactating goats was not affected by vaccination.

Agglutination Reactions: In the animals vaccinated as kids, peak titres between 1:40 and 1:1,280 were reached in about 11 days after vaccination. Thereafter, there was a steady decline and the first kid in which it occurred became negative in 2½ months after vaccination. At the time of autopsy—just over 8 months after vaccination, 11 of the 18 kids vaccinated were still showing positive titres, ranging from 1/10 to 1/40.

In the vaccinated adults maximum titres developed in between one and three weeks after vaccination, and ranged from 1/10 to 1/640. The first adult to return to a negative titre did so in just over six weeks after vaccination. At autopsy, slightly over 7 months after vaccination, 6 of the 13 adults still showed positive titres ranging from 1/10 to 1/40 (5 animals which died earlier are not included). All experimental animals had, of course, been exposed to continuous infection during the last three months of this period.

Stained Antigen Ring Test: All the 18 vaccinated adult goats were lactating at the time of vaccination; the milk of 15 became positive to the ring test. These reactions appeared two weeks after vaccination, and in six animals they persisted throughout the lactations. Following kidding, milk samples were obtained from 11 goats in this group which had completed one pregnancy since vaccination. All showed negative reactions to the ring test at the beginning of the lactation following this pregnancy.

Four of 16 animals vaccinated as kids showed positive ring test reactions when they came into milk at the termination of pregnancy, positive reactions were not found after about two weeks. These four kids had, of course, been exposed to natural infection, but none of them were found to be infected at autopsy.

Milk Cultures: The milk of all lactating goats remained negative on culture between the times of vaccination and challenge, except in two vaccinated goats from which the vaccine strain was recovered. This strain was recovered from the first of these from five successive samples taken twice weekly between 6 to 20 days following vaccination; and from the second animal from 2 successive samples taken weekly at 48 and 55 days after vaccination. The largest number of colonies recovered from any one of these samples was 7.

Results of Challenge Infection: The results are shown in Tables I and II. Examination of cultures made from cotyledons showed three distinct types of results viz: (a) Eleven goats yielded only a few colonies per plate—never more than 10. These are shown in parenthesis in Table II, and are not shown in Table I. It is likely that these few organisms came from an environment very heavily contaminated with *Br. melitensis*: (b) From seven goats, at least several hundred colonies per plate were obtained and (c) from the remainder either no colonies developed or the plates were contaminated. Those contaminated are not included in "total examined" in Table I.

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TABLE I.

	Vaccinated as kids	Vaccinated as adults	Controls
Abortions/Total parturitions	0/16	0/13	3/17
Kids infected/Number of sets of kids examined	0/16	2/16	8/19
Cotyledons infected*/Total examined	0/13	1/16	6/16
Vaginal swab infected/Total examined	0/16	3/9	6/11
Milk positive/Total goats examined	0/16	0/11	4/14
Autopsies positive/Total (any degree of infection)	2/18	2/18	19/22
Autopsies positive/Total (generalised infection only) ...	0/18	0/18	16/22

* Ignoring those cotyledons from which fewer than 10 organisms were recovered.

A X^2 test applied to both sets of autopsy results, i.e. those based on any degree of infection, or to results evaluated on the basis of generalised infection only, shows a highly significant difference between the vaccinated and the controls (P—less than 0.001 in each case). No attempt has been made to apply this test to the other results as it is felt that the number of positives amongst the controls does not justify such a procedure.

TABLE II.

N — Normal birth, A — Abortion, (the figures in the parturition column are the dates of birth or abortion), C — Culture contaminated, G — Generalized infection, L — Localized infection. The degree of infection is indicated by the number of + signs, + : 1-10, + + : 10-100, + + + : 100-1,000, + + + + : over 1,000 colonies, per culture plate. This does not apply to the columns headed kids and autopsy. Localized infection recorded in these tables means infection confined to the lymph nodes of the head except for number 137 which yielded one colony from one suprascapular lymph node. Some detailed comments are necessary:

All strains isolated after exposure to infection showed the characteristics of typical virulent *Br. melitensis*, according to the procedure adopted for differentiating typical virulent *Br. melitensis* from the vaccine strain.

Group 1. *Vaccinated as kids*: The average mean time between the first abortion amongst the donors and kidding in this group was 46 days (range 32 to 70). The time between individual kiddings and autopsies was 59 to 64 days except for three which were autopsied 50, 29 and 26 days, respectively, after kidding. Culture of number 137 produced only one colony from a suprascapular lymph node; it was typical *Br. melitensis* on typing. Similarly, culture of number 134 produced only one colony from a parotid lymph node.

Group 2. *Vaccinated as adults*. The average time between the first abortion amongst the donors and kidding in this group was 62 days (range 27 to 98 days). Of the eleven goats in this group which kidded and did not die, eight were autopsied 40 to 44 days after parturition and the other three after 22, 15 and 9 days respectively.

Infection was detected in only one kid of goat 89, this goat kidded twins, one was negative and the other yielded one colony from each of the following pairs of lymph nodes: parotid, submaxillary and retropharyngeal. Cultures made from the cotyledons yielded two colonies, whereas vaginal swabs, milk and subsequent autopsy of the mother were all negative.

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TABLE II.

Goat No.	Parturition	Kids	Cotyledons	Vaginal Swab	Milk	Autopsy
Vaccinated as Kids.						
126	N 6/3	—	—	—	—	—
127	N 13/2	—	C	—	—	—
128	N 12/2	—	C	—	—	—
129	N 27/3	—	—	—	—	—
130	N 21/2	—	—	—	—	—
131	N 16/2	—	—	—	—	—
132	N 14/2	—	C	—	—	—
133	N 9/2	—	—	—	—	—
134	N 30/3	—	—	—	—	+L
135	N 16/2	—	—	—	—	—
136	N 11/2	—	—	—	—	—
137	Non Preg.					+L
138	N 14/2	—	—	—	—	—
139	N 18/2	—	—	—	—	—
140	N 14/2	—	—	—	—	—
141	N 20/2	—	—	—	—	—
142	N 11/2	—	—	—	—	—
143	Non Preg.					—
Vaccinated as Adults:						
23	N 4/3	—	(+)	—	—	—
24	N 4/3	—	(+)	—	—	—
40	N 10/3	+	+++	++++	—	—
42	Died 17/2	—	—			—
46	Died 21/2	—	—			—
48	N 26/2	—	—	C	—	—
49	N 4/3	—	(+)	+	—	—
66	Non Preg.					—
68	Non Preg.					—
69	N 2/3	—	—	Died 3/3	—	+L
74	N 6/3	—	(+)	Died 7/3		—
84	N 29/3	—	—	—	—	—
86	Died 27/2	—	—			—
87	N 10/3	—	(+)	++++	—	—
89	N 3/3	+	(+)	—	—	—
90	N 16/4	—	—	—	—	—
95	N 9/4	—	—	—	—	+L
97	N 5/3	—	(+)	C	—	—
Non-vaccinated Controls.						
44	Non Preg.					+G
45	N 19/3	—	—	—	—	—
47	N 9/3	—	—	C	—	—
60	N 7/3	—	(+)	++++	++++	+G
62	Died 22/3	+	++++			+G
63	N 3/3	—	—	—	—	+G
64	N 6/3	—	(+)	++	—	+G
65	Non Preg.					+G
76	Died 6/3	—	—			+L
79	N 4/3	—	(+)	C	—	+L
85	N 4/3	—	C	Died 5/3		+G
91	N 13/4	—	C	—	—	+L
92	N 10/3	+	++++	++++	++++	+G
96	N 10/3	+	++++	Died 10/3		+G
98	A 8/5	+	++++	++++	++++	+G
435	Non Preg.					+G
436	A 9/3	+	++++	++++	++++	+G
438	N 29/4	+	—	C	—	+G
439	N 3/2	—	—	—	—	+G
440	N 23/4	—	++++	++++	—	+G
441	A 27/3	+	C	C	Died 31/3	+G
442	N 21/4	+	—	—	—	—

Goat 40 kidded twins; one colony of *Br. melitensis* was recovered from the mesenteric lymph node of one, the other was completely negative. The cotyledons were infected; the vaginal swabs were negative for the first five days after kidding, but plates made from the vaginal swabs of the sixth and seventh days each contained more than 1,000 colonies. Nevertheless, the glands and tissues (including the uterus) yielded no cultures when the goat was autopsied 40 days after kidding.

The vaginal swabs from goat 49 produced one colony on the day following kidding and subsequently were negative. The only other goat in this group to give positive vaginal swabs was number 87 which kidded on the same day as number 40. Again the vaginal swab was negative for the first five days following kidding, four colonies were cultivated from the swab taken on the sixth day and more than a thousand from that taken on the seventh day. Culture results on all glands and tissues were negative at autopsy, 42 days after kidding.

On autopsy, goat 69, which died the day after kidding, yielded 10 *Br. melitensis* colonies from the submaxillary lymph nodes and goat 95 two colonies from the parotid lymph nodes. All the other cultures from these two goats were negative.

Group 3. *Controls.* The average time between the first abortion in the donor animals and the normal kiddings in this group was 66 days. The time between kidding or abortion and autopsy was between 30 and 43 days except for five goats which kidded late and were autopsied 14, 11, 9, 9 and 6 days respectively after kidding.

Goat 438 gave birth to 4 kids; from the stomach contents of one, a single colony of *Br. melitensis* was grown and the other three were completely negative. Goat 442 kidded twins, one negative and the other slightly infected in the lymph nodes of the head and in the testes.

The vaginal swabs from goat 60 were negative for the first three days following kidding, contained a few bacteria on the fourth day and were massively infected on the fifth, sixth and seventh days. A similar state of affairs obtained for goat 64. The uterus of goat 60 was positive at autopsy 31 days after kidding. It is of interest to note that the placenta of goat 63 was negative as were daily vaginal swabs during the week following kidding, yet the uterus was heavily infected on autopsy 43 days after kidding.

Discussion

As the pregnant animals in group 1 were all in their first pregnancy at the time of exposure to infection and the controls mostly in later pregnancies, it has to be assumed that there is no significant difference in susceptibility between different pregnancies if the results are to be strictly compared.

It must also be pointed out that group 1 was exposed to infection for a shorter period during pregnancy than group 3, therefore no attempt should be made to compare the two groups in respect of infection of kids or cotyledons or excretion of *Br. melitensis* from the vagina. The total time of exposure up to autopsy was, however, approximately equal in all three groups. The effect of pregnancy on susceptibility to infection is probably not great; all three non-pregnant controls had a generalized infection at autopsy.

Amongst the adults, the control and vaccinated groups were very similar, but as regards the five vaccinated and five controls which died either just before kidding or just after, it must be mentioned that the vaccinated animals began to die somewhat earlier (see table). All ten have been included in the tables as the first death occurred on 17 February, this goat having been exposed to massive infection from 8 January.

The effect of vaccination on the general health of the vaccinated goats was negligible. The effect of vaccination on the agglutination titres and the stained antigen milk test are undesirable features of this vaccine, but as these tests are unreliable when applied to individual animals, this may not be of so much importance. It is of interest to note that the animals vaccinated as kids appeared to have higher and more persistant titres than those vaccinated as adults.

The occasional excretion of the vaccine strain in the milk of vaccinated goats would be objectionable in areas where the disease is not common, but in Malta where virulent *Br. melitensis* is present in the milk of the majority of herds, the occasional excretion of very small numbers of a strain of reduced virulence is unlikely to be of much importance.

It is considered that this experiment has demonstrated a strong immunity in vaccinated animals. Two vaccinated goats were excreting *Br. melitensis* in large numbers from the vagina following kidding, both infections were, however, of short duration as both goats were completely negative at autopsy 40 and 42 days after kidding respectively. It is felt that the localized infections in the four vaccinated goats classified as positive on autopsy were of no practical significance either to the health of these goats or to any which might come in contact with them. This means that for all practical purposes the vaccinated herd was negative at the time of the autopsies, 6 weeks to two months after the kiddings, whereas the majority of the animals in the non-vaccinated herd had a generalized infection at this time and four of them were excreting *Br. melitensis* in large numbers in the milk.

It seems probable that the concentration of infection to which these experimental goats were exposed was greater than that met in the average infected goat house in Malta, judging by the high proportion of non-vaccinated controls which became infected during the relatively short period of exposure of about four months.

The small number of bacteria unexpectedly recovered from the cotyledons of certain goats (shown in parenthesis in Table II) is difficult to explain, but seemed to follow the abortion of a donor goat on 3 March. The dates of kidding of the goats in question were March 3, 4 (3 kiddings), 5 (2 kiddings), 6 (3 kiddings), 7, and 10 respectively. No abortions occurred during the period when group 1 were kidding. It is the writer's opinion that the majority of these organisms reached the cotyledons by contamination either from the floor of the pen or the hands of the attendant.

It is perhaps unfortunate that the experimental animals were not exposed to infection earlier in pregnancy. Had this been done, it is possible that significant differences between vaccinated and controls would have resulted in respect of abortion rate, infected kids, excretion of organisms in the milk, etc.

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Conclusion

Within the limits of this experiment it may be concluded that the living attenuated vaccine developed by Elberg and Faunce, 1957, is safe to use on the non-pregnant female Maltese goat when vaccinated either as a kid or as an adult. The vaccine causes no appreciable interference with normal health or with milk yield and local reactions are minimal. This vaccine has two somewhat serious drawbacks. It causes a severe and prolonged sero-agglutination reaction and bacilli may be excreted occasionally in small numbers in the milk of goats vaccinated during lactation.

A high degree of immunity was demonstrated in goats exposed to very heavy natural infection during and immediately after the pregnancy following vaccination. A small number of vaccinated goats excreted *Br. melitensis* from the vagina following normal kidding, but this excretion continued for a shorter period than in non-vaccinated infected goats.

Acknowledgments

The technical assistance of Miss P. Schneider of the University of California during the kidding of the experimental animals is gratefully acknowledged. Dr. Elberg, in addition to making available the services of Miss Schneider, arranged for the supply of vaccines and gave much valuable advice. Dr. Martin M. Kaplan of WHO, assisted greatly by the supply of medium, antibiotics, etc.

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REVIEWS

THE TOPOGRAPHICAL ANATOMY OF THE DOG. By O. Charnock Bradley, revised by T. Grahame. 6th Edition 1959. Edinburgh. Oliver & Boyd. 36/-.

The sixth edition of this standard text stands in no need of a conventional review since it continues the now familiar pattern. In his preface Professor Grahame declares his adherence to Bradley's wish to supply a simple guide to the anatomy of the dog for the use of students and this task is fulfilled admirably. There may be a need for a more comprehensive work on canine anatomy but bearing in mind the object of the authors it is unfair to criticise this book for its lack of detail. In the reviewer's opinion any serious enlargement of its scope would destroy its value and render it unsuitable for the use of undergraduates in the dissection room.

Readers familiar with the previous edition will recognise a number of improvements and particularly an increase in the number of text figures and plates. The radiographs depicting the blood supply to the viscera are especially welcome but certain others, notably that of the skull, are disappointing and one is slightly irritated by the continued inversion of the pelvic radiograph.

XUM

CLINICAL VETERINARY SURGERY. R. H. Smythe, Vol. 1. (1959) pp. 355 (including 57 figs.) together with 35 photographic reproductions on art paper. London. Crosby Lockwood. 42/- net.

A book written by one with such versatility and clinical ability is bound to be both interesting and stimulating. The reviewer has known the author for many years and he can hear the voice of R. H. in the written word and would fain argue with him concerning some of the opinions expressed. Argue, not so much perhaps to gain a point as to benefit from the clinical acumen inherent in a man of his critical observation and masterly grasp of the art of general veterinary practice.

Smythe, since his retirement from general practice, has occupied himself with writing; much of his work has been for the laity, and the present book rather tends to fall between two stools. It is written in a lucid and easy style almost suitable for the general reader and may be more acceptable to those who have been some years qualified than to the recent graduate who may, with youthful impatience, regard the over-simplification of such phenomena as blood clotting and the cardinal signs of acute inflammation—which should be known by all who have any knowledge of pathology—as somewhat elementary and, perhaps, redundant.

Whilst some may not be prepared unreservedly to agree with all the opinions expressed in this book, it is, however, undoubtedly full of much sound and practical advice, so that it should prove of especial interest. The ability to diagnose lameness in the horse is nowadays rarely of that high order which characterised many of those who qualified before the first world war. The somewhat artistically amateurish line drawings are of real worth, since one is almost at once made so familiar with the clinical picture that diagnosis is reduced almost to simplicity, for there is an exaggerated emphasis on the essential features which brings home to one an unmistakable intimacy with the condition portrayed and recalls—to those who have had past experience of the conditions—memories which confirm the essential features which the author so masterfully conveys to the eye. This is well illutsrated if one compares the photograph reproduced in plate 15 (a) with the line drawing in figure 22—both of which depict radial paralysis in the horse. Incidentally, reference to this condition in the index is alphabetically misplaced.

To attempt to compress into a small volume the wide field covered by the title must inevitably lead to gaps which one would have wished had been more amply dealt with. Nevertheless a great and varied amount of sound clinical knowledge has been presented and few veterinary readers will fail to benefit by reading and possessing —for a modest outlay—this somewhat unconventional work, which can be read without undue effort and with a fair degree of pleasure as well as profit.

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NEWS

The Wellcome Foundation Limited announce that Mr. G. H. Macdonald, M.P.S., formerly Manager of the Professional Services Department, has been appointed Manager of the Home Sales Department (Veterinary). Mr. J. W. Barber-Lomax has been appointed Manager of the Professional Services Department. Mr. Barber-Lomax was formerly Veterinary Information Officer.

NOTICE

Smith Kline & French Laboratories Ltd., Coldharbour Lane, London, S.E.5, announce that 'Bifuran' Soluble Tablets, for the prevention and treatment of enteritis in pigs and coccidiosis in poultry, are available in a new size—containers of 250 tablets, price 37/6 each retail. This size has replaced the 1,000 tablet container. The price per tablet remains the same.

Publisher's Notices

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